Faculty of Engineering & Technology

M.Tech. (Materials Science & Technology)

1. **Crystal Physics and Engineering Materials :** Introduction, Crystal Structures, Unit cells, crystal systems, Crystallographic point, direction and planes, Magnetic properties of materials. Types of magnetic materials. Zero resistivity, Meissner effect, Type I and Type II Superconductors, High Temperature Superconductors, BCS theory (qualitative), Josephson effect, SQUIDS, Applications of Superconductors.
2. **Thermodynamics :** Introduction, Laws of thermodynamics, Thermodynamics Processes, Variables, Thermodynamics Potential and their interrelations, Heat Engine, Efficiency of heat engine, Carnot cycle theorem, Tempeature Entropy diagram, Maxwell's thermodynamical relations.
3. **Electromagnetics :** Introduction, Guass divergence and stokes theorem, Poission's and Lapalce's equations Maxwell's Equations, Travelling Electromagnetic Wave, Quantitatively, Energy Transport & the Poynting Vector.
4. **Particles and Waves :** Mechanism of X-ray production (continuous and characteristics X-rays, Duane-Hunt limit), Diffraction of X-rays (Bragg Planes, Bragg's law, Bragg Spectrometer), Compton effect, Pair production, Phase and group velocities, Electron microscopes, Uncertainty principle, Applications of Uncertainty principle.
5. **Quantum Mechanics :** Introductioin to quantum mechanics, Wave function, Conditions necessary for physically acceptable wave function, Probability density and probability, Schrodinger equation (Time dependent form and steady state or time independent form), Eigenvalues and Eigenfunctions, Expectation values, Particle in a box (Infinite potential well), Finite potential well, Tunnel effect.
6. **Masers and Lasers :** Basic principle, Einstein coefficients for Induced absorption, Spontaneous Emission and induced emission, Ammonia maser and its applications, Ruby and He-Ne Lasers, Semiconductor laser, Spatial and temporal coherence, Characteristics of lasers and its applications.
7. **Fibre Optics :** Basic principle, Fibre construction and dimensions, Light Propagation in fibres, Step index and graded index fibres, Signal distortion in optical fibres, Transmission losses, Light wave communication in optical fibres, Fibre Optics in medicine and industry.
8. **Semiconductors :** Elemental and compound semiconductors, Energy bands, Direct and indirect semiconductors, Electrons and holes, Effective mass, Intrinsic material, Extrinsic material, Fermi level, Electron and hole concentration at equilibrium. Temperature dependence of carrier concentrations Compensation and space charge neutrality, Conductivity and mobility, Hall effect in semiconductors.
9. **Statistical Mechanics :** Statistical distribution, Maxwell-Boltzmann statistics, Molecular energies in an ideal gas, Quantum statistics. The three statistical distribution functions, Specific heat of solids Free electron in a metal and Fermi energy, Electron – energy distribution, Dying starts, White dwarfs, Neutron starts, Blackholes.
10. **Nuclear Physics :** Radioactivity and nuclear reactions, nuclear reactors, Nuclear detectors (names and general working principle), Gas filed detectors, Scientillation detectors, Track detectors, Semiconductor detectors.